COMPOSITION, STRUCTURE AND DENSITY CHANGES OF PASSERINE COMMUNITIES IN LAUREL FOREST, EXOTIC FOREST AND AGRICULTURAL FIELDS ON MADEIRA ISLAND

By OLIVEIRA, P. *, COSTA NEVES, H. * & SILVA, I. *

With 2 figures, 1 table and 1 appendix

ABSTRACT. At a specific or sub-specific level the passerine fauna of Madeira is almost entirely endemic to the macaronesian region. In 1990 the Parque Natural da Madeira started a monitoring scheme to evaluate changes in the density, structure and composition of different passerine communities. This was part of a national project (Comunidades de Aves Terrestres).

Yearly censuses were carried out in three different habitats: Indigenous forest, exotic forest and agricultural areas.

We concluded that the composition of the passerine communities of these three habitats is based on a small number of species. We also concluded that they appear to be stable, not showing strong fluctuations, or heavy population decreases, over the last five years. This stability may be a good indicator of the health of the environment.

INTRODUCTION

The passerine fauna of Madeira Island consists of a small number of species but at a specific or sub-specific level, this fauna is almost entirely endemic to the macaronesian region. Even though most of these endemic birds are widely distributed all over the island (and in some cases very abundant) their very restricted world range makes them extremely important for conservation because of their scientific and ecological importance.

The dynamic ecological relationship between birds and their habitats makes them very sensitive and valuable indicators of the health of the natural environmental. They may occupy habitats known to be changing, or perhaps be candidates for recognising adverse effects of pesticides or pollution. In this way a knowledge of the passerine community's

* Parque Natural da Madeira, Quinta do Bom Sucesso, Caminho do Meio - 9050 PORTUGAL

Bol. Mus. Mun. Funchal, Sup. no. 5: 291-298, 1998. ISSN 0870-3876

composition and structure, and any changes in these parameters over time, can provide very useful information on the health of both the passerine fauna and of the island‘s environment in general (KREBS et al. 1994).

With the above in mind the PNM started a long-term monitoring scheme in1990. Such scheme was an independent part of a national project (CAT).

Objectives

The fundamental aims of this long term project are to:

1. Characterise the passerine communities present in three different habitats: Indigenous forest, Exotic forest and Agricultural or humanised rural areas.
2. Evaluate changes in composition, population trends and structure of the different passerine communities.
3. Produce a baseline to which population changes over many years can be compared.

Study areas and general habitat characteristics

We worked in two distinct study areas. One encompassed indigenous laurel forest in the north of the island at Ribeiro Bonito and Ribeira de S. Jorge. The forest in this area is of high conservation status and is dominated by *Ocotea foetens* and *Laurus azorica*, trees that are usually over 25 m in height. Other abundant tree species in our sampling area are *Persea indica*, *Myrica faya* and *Clethra arborea* (NEVES et al. in press).

Exotic forest and agricultural fields were sampled in the south of the island on Levada do Norte between the villages of Camacha and Stº da Serra. In this area the forest was dominated by mature *pinus spp* or *Eucalyptus globolosa*. The agriculture fields are mainly subsistence and because of the terrain in Madeira, carried out in small terraced fields. We studied areas where the agriculture is mainly of subsistence. The usual crops are potatoes, carrots, cabbages and fruit trees. Natural fertilisers are used but there is also heavy use of chemical pesticides and herbicides.

METHODS

The data presented here were collected between 1990 and 1995.

The censusing was carried out in the breeding season using point counts of five minutes duration (FULLER and LANGSLOW 1984). This particular time period was used as although the vegetation was sometimes dense, only a small number of species were likely to be present. The number of points in each habitat ranged between 15 (in exotic and agriculture areas) and 20 (in the indigenous laurel forest area), and the distance between them was about

400m. From year to year we maintained the exact location of each point. Every bird seen or heard, regardless of its distance from the observer, was recorded. We did not try to include any distance estimates to bird contacts because of the potential bias introduced by different observers over the lifetime of, what is planned to be, a long term project (BIBBY et al. 1993). Essentially we tried to keep the methodology as simple as possible.

Species' relative densities were obtained as the average number of birds seen or heard at each point (nr. of contacts/nr. of points). The changes in relative densities were used to evaluate population trends.

Species richness is expressed as the number of species present in each habitat. To highlight any changes in the structure of these communities we used the Shanon-Wienner diversity and the Equitability indices (LUDWIG and REYNOLDS 1988). We did not use the index to compare different habitats but to compare the same habitats between years.

RESULTS

Composition

None of the habitats showed any changes in species richness over the five years and table 1 shows the composition of the different communities.

TABLE 1 - List of the species Present (1) or Absent (0) in the three different habitats studied between 1990 and 1995 (E=Exotic forest; L=Laurel forest; and A=Agriculture)

	E	L	A
Erithacus rubecula (Er)-Papinho, Robin	1	1	1
Sylvia atricapilla (Sa) Toutinegra, Blackcap	1	1	1
Regulus ignicapillus (Ri) Bisbis, firecrest	1	1	1
Turdus merula (Tm) Melro preto, Blackbird	1	1	1
Fringilla coelebs (Fc) Tentilhão, Chaffinch	1	1	1
Carduelis carduelis (Cc) Pintassilgo, Goldfinch	1	0	1
Serinus canaria (Sc) Canário da terra, canary	1	0	1
Motacilla cinerea (Mc) Lavandeira, Grey Wagtai	1	1	1

Eight species were present in the exotic forest; six in the Laurel forest; and eight on the agriculture fields. Except for *C. carduelis* and *S. canarius*, which do not occur in the Laurel forest, the other 6 species are common to the three habitats.

Population trends

The relative densities (nr. contacts/nr. of points) obtained in each habitat are shown in Fig. 1 (the actual figures together with their standard deviations are in Appendix 1)

APPENDIX 1

	Exotic											
	90		91		92		93		94		95	
	D	S	D	S	D	S	D	S	D	S	D	S
Er	0,7	1,25	1,2	1,62	1,78	1,99	1,76	1,56	1,75	1,67	2	2,07
Sa	0,3	0,48	0,9	0,99	0,67	1	0,8	1	1	1,31	1	1,2
Ri	0,4	0,7	1	1,05	0,78	1,09	0,5	0,67	0,25	0,46	1	1,07
Tm	1,3	1,42	1,2	1,23	0,89	1,05	1,5	0,9	2,63	2,07	3	1,6
Fc	0,5	0,71	0,9	1,6	1,89	1,62	1,95	1	1	1,69	2,38	1,3
Cc	0,1	0,32	0,1	0,32	0,11	0,33	0,13	0,1	0,13	0,35	0,25	0,71
Sc	0,2	0,42	0,3	0,67	0,33	0,71	0,5	0,2	1,5	0,71	1,13	1,73
Mc	0,75	0,5	0,3	0,48	0,22	0,44	0,13	0,35	0,13	0,35	0,25	0,46
	Laurel											
	90		91		92		93		94		95	
	D	S	D	S	D	S	D	S	D	S	D	S
Er	0,3	0,57	0,3	0,47	0,28	0,46	0,3	0,23	0,4	0,33	0,5	0,23
Sa	0,2	0,52	0,2	0,52	0,28	0,75	0,3	0,34	0,35	0,52	0,4	0,4
Ri	2	1,78	1,9	2	2,94	1,35	2	1	1,6	1	2	1,2
Tm	0,95	0,6	0,75	0,72	0,89	0,9	0,99	0,56	1,8	1	1,99	1
Fc	2,2	1,47	1,1	1,12	1,78	1	1,9	1,1	1,9	1,4	2	1,3
Cc	0	0	0	0	0	0	0	0	0	0	0	0
Sc	0	0	0	0	0	0	0	0	0	0	0	0
Mc	0,15	0,37	0,1	0,31	0,17	0,38	0,1	0,9	0,1	0,2	0,2	0,1
	Agriculture											
	90		91		92		93		94		95	
	D	S	D	S	D	S	D	S	D	S	D	S
Er	1,6	1,26	1,89	1,05	1,67	1	1,5	1	1,45	1,21	1,82	1,17
Sa	1,4	1,96	1,56	1,24	2,33	1,32	2,4	1,95	2,55	1,21	3	1,61
Ri	0,1	0,32	0,89	0,93	1,33	1,12	1	0,6	0,36	0,67	0,91	0,7
Tm	1,7	1,77	1,78	1,39	1,78	0,97	1,8	0,9	1,82	1,4	2,91	1,97
Fc	1,5	1,08	1,56	1,42	1,78	1,3	1,8	1,22	2,09	1,97	1	1,18
Cc	0,2	0,42	0,33	0,71	0,33	1	0,36	0,29	0,27	0,65	0,36	0,5
Sc	0,5	0,71	0,56	0,73	1,22	0,44	1,2	1	1,18	1,6	1,82	1,33
Mc	0,2	0,42	0,11	0,33	0,22	0,44	0,22	0,33	0,18	0,4	0,27	0,47

D- Relative densities (nº contacts/nº points) obtained in each habitat.

S- Stantard deviations

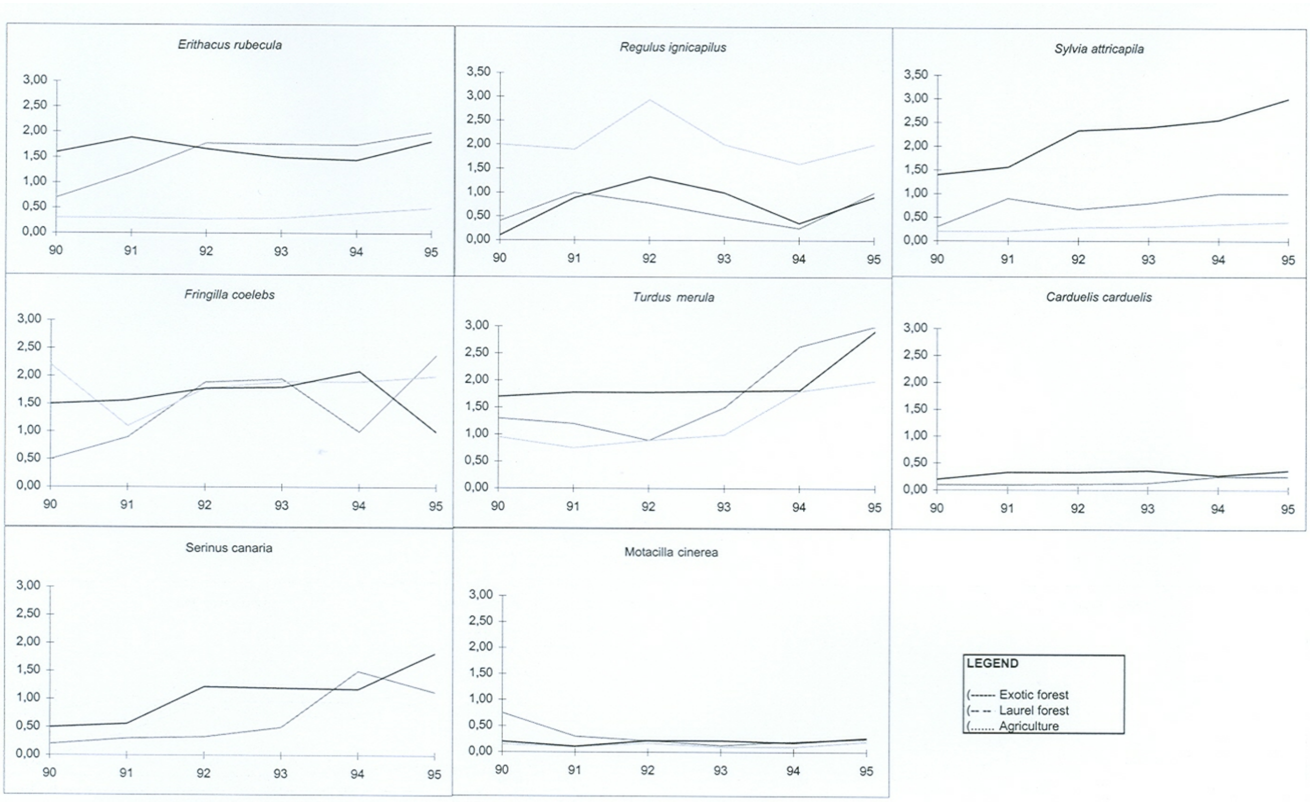

Fig. 1 - Relative densities obtained for all species.

D- Relative densities (nº contacts/nº points) obtained in each habitat.
S- Stantard deviations

Almost all the species show a higher relative density in 1995 than in 1990. The only three to which this does not apply are: *R. ignicapillus*, in the laurel forest; *F.coelebs* in the laurel and agricultural; and *M. cinerea* in the exotic forest. In these cases we have lower densities in 1995 than in 1990. On the whole however, there are no marked fluctuations in population densities except for: *E. rubecula* in the exotic; *S. atricapilla* and *S. canaria* in the agricultural; and *T. merula* in all the habitats. In these cases there has been a considerable increase.

Changes in communities

The maximum and minimum Shanon-Wienner Diversity and Equitability indices for the three communities are shown in Fig. 2.

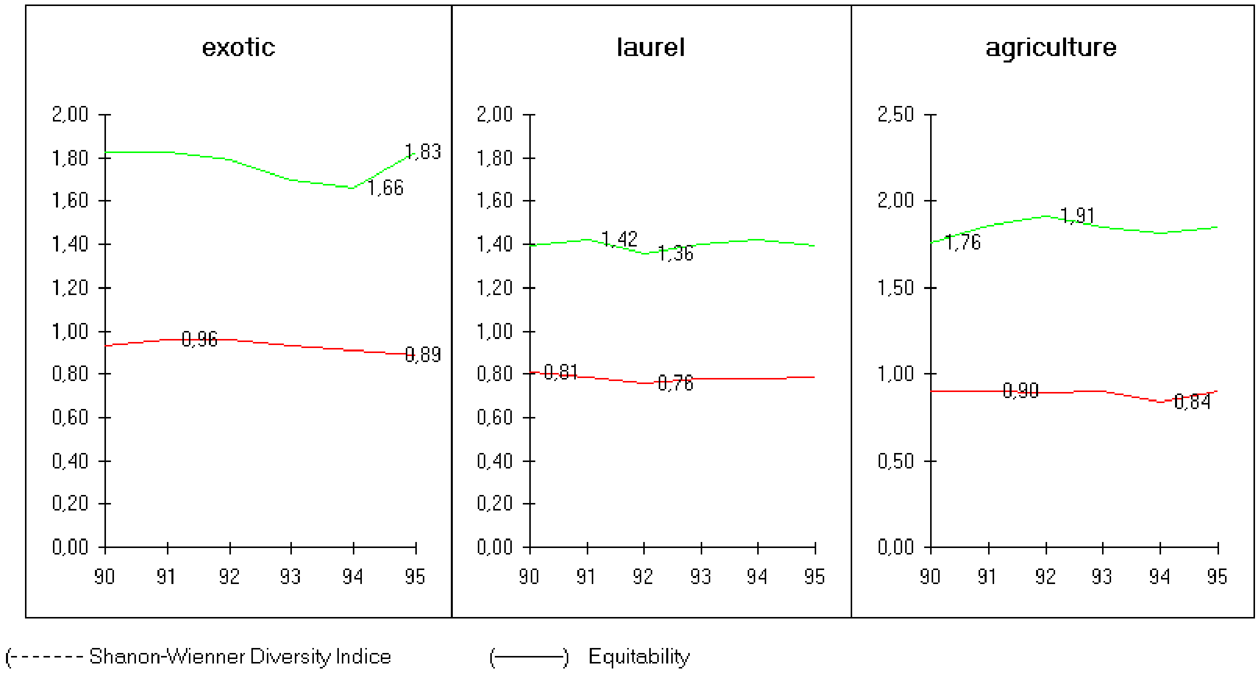

Fig. 2 - Shanon-Wienner Diversity and Equitability Indices found for the three comunities over the five years of the study. (Maximum and Minimum values are shown)

Although the diversity index values show slight fluctuations, they tend to be fairly constant throughout the five year period. The same applies for the equitability index values. Although the study was not designed to compare habitats, in these restricted samples the exotic and agricultural habitats have higher diversities than the indigenous laurel forest.

DISCUSSION

As expected, the passerine fauna of the studied habitats is relatively poor in species number. Considering the low vegetation diversity in these areas, the low species number is not surprising. Links between the habitat diversity and bird species ratios has been drawn by many authors (e.g.; MACARTHUR and MACARTHUR 1961; CODY 1985; WIENS 1989).

The similarity in species composition between the habitats is related to the ecology and general biology of the species present on Madeira. Most of these birds are found all over Europe (albeit as different sub-species) and have successfully colonised and exploited a number of different habitats (forests, scrub, parks, etc...)(CRAMP 1985; TUCKER and HEATH 1994). They are not, therefore, extremely specialised and within Madeira can survive in all the habitats studied.

In general there was an increase in population sizes over the period and this fluctuation may be part of natural population. One factor that probably played an important role in this is the good weather the island experienced during the last three winters (93, 94 and 95). Although we did not collect meteorological data on our study areas, the general information for the island shows that we had, during the winter months, less rain and higher minimum temperatures. These two factors may well be responsible for a low winter, which can have a significant role on the increase of the natural populations (SINCLAIR 1989).

Although farmers use large amounts of pesticides and herbicides (the use of very lethal products is widespread and not under control), the agricultural areas still support surprisingly high densities of birds. However, we have no information on the avian community prior to the use of chemicals and a review of their use and research on their effects are urgently needed.

In conclusion this work had shown that there exist a number of indications of the stability and health of the communities under study. However the most important thing about this work is that we produced a baseline to which population changes over many years can be compared.

REFERENCES

BIBBY, CJ.; N.D. BURGESS & A.H. HILL:
1992. *Bird Census Techniques*. Academic Press. London.

CODY, M.L.:
1985. An introduction to habitat selection in birds. *in* Cody M.L. (Ed.) *Habitat selection by birds*. Academic Press, London.

CRAMP S.:
1985. *The birds of the Western Paleartic, Vol. 4.* Oxford University Press. U.K.

FULLER, R.J. AND D.R. LANGSLOW:
1984. Estimating number of birds by point counts: how long should a point last? *Bird study* **31**, 195-202.

KREBS, C.J.:
1994. *Ecology. The experimental analysis of distribution and abundance.* Harper Collins. New York.

LUDWIG, J.A. & REYNOLDS, J.F.:
1988. *Statistical Ecology. A primer on methods and computing.* John Wiley & Sons. New York.

MACARTHUR, R.H. AND MACARTHUR, J.:
1961. On Bird Species Diversity. *Ecology* **42**, 594-598.

NEVES H.C.; VALENTE, A., FARIA, B; SILVA I.; GOUVEIA, N.;, P; SILVA, P.; AND OLIVEIRA P.:
1996. *Laurissilva da Madeira. Uma avaliação quantitativa e qualitativa*. Parque Natural da Madeira.

SINCLAIR, A.R.E.:
1989. Population regulation in animals. In *Ecological Concepts*, ed. J.M. Cherrett, pp.197-241. Blackwell, England.

TUCKER, G.M. & M.F. HEATH:
1994. *Birds in Europe: Their Conservation Status*.: Birdlife International (Birdlife Conservation Series nº 3). Cambridge, UK.

WIENS, J.A.:
1989. *The Ecology of Bird Communities, vols 1 and 2.* Cambridge University Press. UK.